

(19) World Intellectual Property  
Organization  
International Bureau



526,361  
Rec'd PCT/PTO 02 MAR 2005



(43) International Publication Date  
11 March 2004 (11.03.2004)

PCT

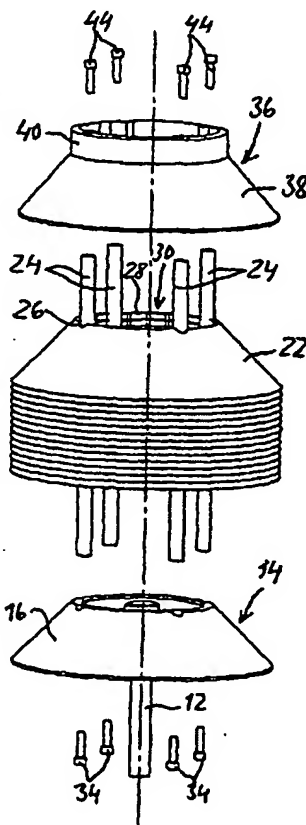
(10) International Publication Number  
WO 2004/020105 A2

- (51) International Patent Classification<sup>7</sup>: B04B
- (21) International Application Number:  
PCT/SE2003/001357
- (22) International Filing Date:  
2 September 2003 (02.09.2003)
- (25) Filing Language: Swedish
- (26) Publication Language: English
- (30) Priority Data:  
0202587-2 2 September 2002 (02.09.2002) SE
- (71) Applicant (for all designated States except US): 3NINE  
AB [SE/SE]; P.O. Box 1163, S-131 27 Nacka Strand (SE).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): LAGERSTEDT,  
Torgny [SE/SE]; Döbelnsgatan 89, S-113 52 Stockholm

- (SE). INGE, Claes [SE/SE]; Kristinavägen 15, S-131  
50 Saltsjö-Duvnäs (SE). FRANZÉN, Peter [SE/SE];  
Månstorpavägen 22, S-146 45 Tullinge (SE). MAEHANS,  
Olev [SE/SE]; Plåtslagarvägen 66, S-146 36 Tullinge (SE).  
SANDGREN, Martin [SE/SE]; Landåvägen 12, S-131 49  
Nacka (SE).
- (74) Agents: ALBIHNS STOCKHOLM AB et al.; P.O. Box  
5581, Linnégatan 2, S-114 85 Stockholm (SE).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC,  
SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA,  
UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),

[Continued on next page]

(54) Title: A DISC STACKING ARRANGEMENT



(57) Abstract: Centrifuge for purifying flowing fluid media, comprising a plurality of stacked concentric disc elements (22), each provided with a central fluid inlet hole (30). The disc elements have through openings (26) by means of which the disc elements are slipped onto at least three substantially axially extending, circumferentially spaced guide elements (24) for guiding the disc elements circumferentially and radially. The disc elements (22) are held together by end elements (14, 36) at the ends of the stack of discs. The guide elements (24) are in the form of completely separate, combined guidance and tensile rods, which are disposed so as not to encroach on the central flow space in the disc stack of the centrifuge. The through openings (26) in the disc elements (22) are made as notches, radially directed from the central fluid inlet hole (30) in the disc elements (22), and the tensile rods are disposed to be inclined somewhat towards the rotational centre from the lower end element when mounting the disc elements.

WO 2004/020105 A2



Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

- *without international search report and to be republished upon receipt of that report*

## A DISC STACKING ARRANGEMENT

Technical field

5 The present invention relates to an arrangement in a centrifuge for purifying flowing fluid media, said centrifuge comprising a plurality of concentrically stacked disc elements provided with at least a centrally disposed fluid inlet hole, said disc elements having through openings by means of which the disc elements are slipped onto at least three essentially axially standing, circumferentially spaced, guide elements for  
10 guiding the disc elements circumferentially and radially, and said disc elements being held together by end elements at the ends of the stack of discs, said guide elements being in the form of separate tensile rods, which are disposed to cooperate with the end elements in such a manner that the end elements are displaceable relative to each other when compressing the disc elements, means being arranged to  
15 locking engage the combined guiding and tensile rods to hold the disc elements in a compressed state.

Background of the invention

20 In arrangements of this type for purifying a liquid from undesirable particles there is sometimes used a fixed guiding and tensioning element in the form of a central so-called wing cross to make possible both radial and polar guidance and compression of a large number of stacked conical plates or disc elements ("insert plates") with the aid of pressure elements at either end of the stack of discs. The pressure elements can be upper and lower end plates which are coupled together via threads  
25 with the fixed guidance and tensioning element, or by a housing surrounding and rotating together with the disc stack and having upper and lower halves coupled together. By tightening the end plates to the guidance and tensioning element or to the halves of the housing, the disc elements are pressed together in the stack to make a  
30 stable unit.

In centrifuges for gas purification, it is, however, not advantageous to work with an outer rotating housing. Nor is the use of a central wing cross suitable. This limits the flow space for the gas medium flowing into the centre of the disc stack. Furthermore, the mounting of the disc elements on the fixed guide elements is problematic and requires precision and narrow dimensional tolerances.

US-A-5 637 217 describes a centrifuge for separating particles from a circulating liquid and has features of the type which are disclosed in the preamble to claim 1. The through openings through the disc elements in this centrifuge are, however, not made to simplify the mounting of the disc element and the tensioning bars.

#### The purpose and solution of the invention

One purpose of the present invention is to achieve a centrifuge in which the disc elements can be easily assembled into a disc stack on the guide elements and be compressed by the end compression elements cooperating with the guide elements, while at the same time assuring that there will be a large central flow space for the inflowing medium to be purified.

For this purpose the arrangement described by way of introduction is characterized according to the invention in that the through openings in the disc elements for the tensile rods are in the form of notches radially directed from the central fluid inlet hole in the disc elements.

In order to additionally simplify assembly of the disc elements, the tension bars are disposed when the disc elements are slipped onto the same to be able to be inclined somewhat inwards towards the rotational centre from one end element to facilitate stacking. After mounting of the last disc element, the bars are pressed outwardly for mounting of the upper end element.

In the event of a rotor breakdown, to prevent the more rigid end elements from striking and damaging a surrounding housing, these are preferably made with an outer diameter which is less than the outer diameter of the disc elements. The more deformable, thin disc elements will strike the housing instead.

5

Additional features and advantages of the present invention will be evident from the following detailed description with reference to the accompanying drawing.

#### Short description of the drawing

10

Fig. 1 is a partially sectioned side view of a centrifuge arrangement according to the present invention;

Fig. 2 is a plan view of the arrangement in Fig. 1;

Fig. 3 is an exploded view in perspective of the arrangement in Figs. 1 and 2; and

15 Fig. 4 is an enlarged detail view of the area circled in Fig. 1, showing the coupling together of an upper pressure element with a guiding and tensioning element in the arrangement according to Figs. 1-3.

#### Detailed description of a preferred embodiment

20

In Fig. 1, 10 designates a rotor of a centrifuge for purifying a gas medium. The rotor 10 has a bottom element 14 which is integrated with a drive shaft 12 and has a conical collar 16, which is connected via a radial web portion 18 and a hub 20, to a centrally placed drive shaft 12. Onto the bottom element 14 there are stacked a plurality  
25 of spacer elements in the form of conical discs 22. The discs 22 are stacked with the aid of four axially directed guide rods 24, which are mounted evenly distributed peripherally. Each disc 22 has, for this purpose, four corresponding guide grooves or through openings 26, which preferably extend radially into the discs 22 from an inner circumferential edge 28, which defines a central inlet hole 30 for the gas me-  
30 dium to be purified. The discs 22 are held spaced from each other a small distance

in the axial direction by means of suitable spacers, e.g. radial ridges 32, which are indicated in Fig. 4.

5 The guide rods 24, which can be made as a long tubular elements with an inner thread at their ends, are, at their lower ends shown in Figs. 1 and 3, fixed in the bottom element 14 by means of screws 34. At the upper ends of the guide rods 22, a pressure plate 36 is applied. The pressure plate 36 has a conical collar portion 38 which abuts against the top of the upper disc 22 in the stack as well as a hub portion 40 with four mounting holes 42 (Fig. 4) for the upper ends of the guide rods 24.

10 Screws 44 engage the thread in the upper ends of the guide rods 22 and press the conical collar portion 38 against the upper disc 22 in the stack, to thereby hold the discs 22 stably together and press them between the bottom element 14 and the pressure plate 36 of the rotor 10. The rods 24 are in this case both guide elements for stacking the discs 22, and pressure elements for pressing them together, at the same

15 as they encroach minimally on the central flow space for the gas medium to be purified, flowing into the rotor.

In order to facilitate slipping the discs 22 onto the guide rods 24, the guide rods are preferably disposed during assembly to be inclined somewhat inwardly towards the

20 rotational centre. This can be achieved by making the mounting holes for the guide rods 24 and the bottom element 14 somewhat inwardly inclined or by bending the rods 24 somewhat inwardly by means of the first mounted disc element. When mounting the pressure plate 36 on top of the uppermost disc 22, the rods 24 can be pressed into their respective through openings 26 in the discs. Any clearances or

25 gaps between the rods 24 and the through openings 26 (guide grooves) can be taken up by the rods being pressed outwardly by the centrifugal forces during operation. Such an intentional gap can further facilitate the mounting of the discs 22.

It is suitable to make the pressure plate 36 and the bottom element 14 with an outer

30 diameter which is somewhat less than the outer diameter of the discs 22. In the

event of breakdown of the rotor shaft 12, the more deformable discs 22, preferably made of a plastics material, will come into contact with a surrounding housing, instead of the more rigid bottom element 14 or the pressure plate 36, coming into contact with the surrounding housing, thus minimising damage to the centrifuge.

5

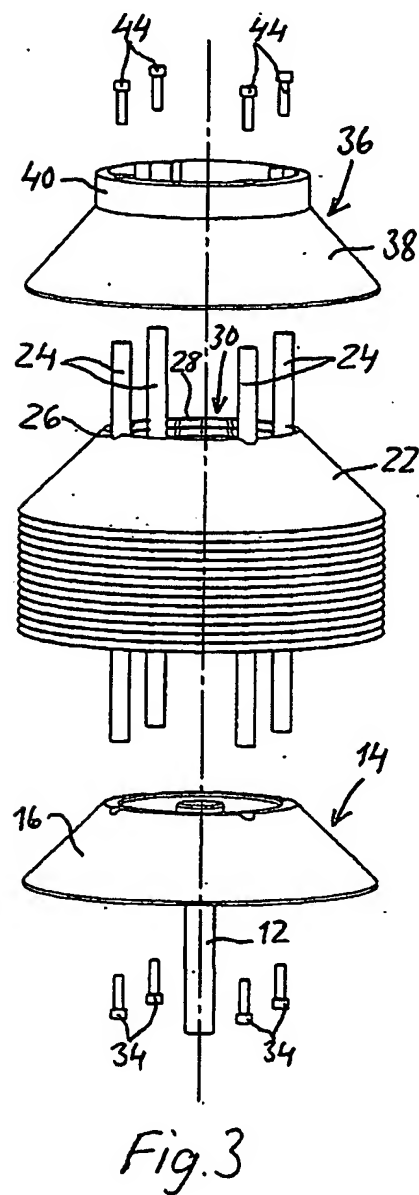
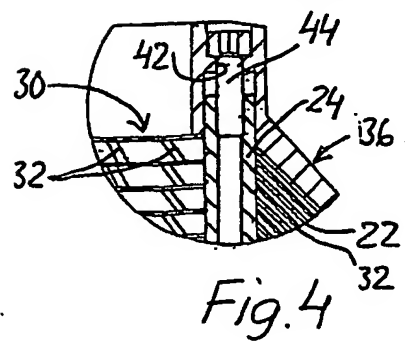
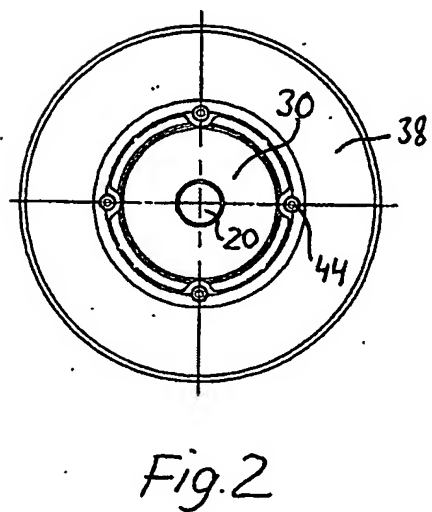
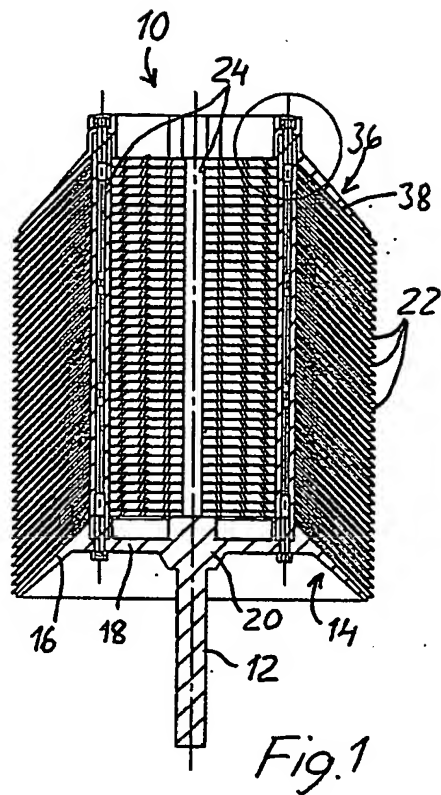
Many modifications of the device are conceivable within the scope of the invention. For example, instead of screws 34, 44, nuts can be used which engage externally threaded end portions of the guide rods 24. The number of guide rods 24 should be at least three, but can be more than four. Furthermore, the end portion of the rotor, integrated with the drive shaft, can be a displaceable pressure plate for the stack of discs, while the opposite end element can be a fixed component with guide rods on which the discs are mounted.

10

## Claims

1. Arrangement for a centrifuge for purifying flowing fluid media, said centrifuge comprising a plurality of concentrically stacked disc elements (22) provided with  
5 at least a centrally disposed fluid inlet hole (30), said disc elements (22) having through openings (26) by means of which the disc elements (22) are slipped onto at least three essentially axially standing, circumferentially spaced, guide elements (24) for guiding the disc elements circumferentially and radially, and said disc elements (22) being held together by end elements (14, 36) at the ends of the  
10 stack of discs, said guide elements being in the form of separate tensile rods (24), which are disposed to cooperate with the end elements (14, 36) in such a manner that the end elements are displaceable relative to each other when compressing the disc elements (22), means (34, 44) being arranged to lockingly engage the combined guidance and tensile rods (24) to hold the disc elements (22)  
15 in a compressed state, characterized in that the through openings (26) in the disc elements (22) for the tensile rods (24) are in the form of notches radially directed from the central fluid inlet hole (30) in the disc elements (22).
2. Arrangement according to Claim 1, characterized in that the tensile rods (24)  
20 are arranged upon slipping of the disc elements (22) onto the same, to be inclinable somewhat inwards towards the rotational centre from one of the end elements (14) to facilitate mounting.
3. Arrangement according to Claim 1 or 2, characterized in that the end elements  
25 (14, 36) have an outer diameter which is less than the outer diameter of the disc elements (22).





# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>68528-72853</b>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">FOR FURTHER ACTION</div> <div style="font-size: small;">see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</div> </div>
International application No. <b>PCT/SE 03/01357</b>	<div style="display: flex; justify-content: space-between;"> <div>International filing date (day/month/year) <b>2 Sept 2003</b></div> <div>(Earliest) Priority Date (day/month/year) <b>2 Sept 2002</b></div> </div>
Applicant <b>3Nine AB et al</b>	

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 3

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☐ None of the figures.

1  
INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/01357

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC7: B04B 7/14**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

**IPC7: B04B**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**SE,DK,FI,NO classes as above**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL, WPI, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5637217 A (HERMAN ET AL), 10 June 1997 (10.06.97), column 9, line 10 - line 29, figures 2-6  --	1-3
A	US 4350282 A (DUDREY ET AL), 21 Sept 1982 (21.09.82), column 3, line 52 - column 4, line 41, figures 4,3, abstract  -- -----	1-3

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

**13 November 2003**

**21-11-2003**

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

**ULF NYSTRÖM/BS**  
Telephone No. +46 8 782 25 00

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

06/09/03

International application No.

PCT/SE 03/01357

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	5637217	A	10/06/97	AU 688201 B	05/03/98
				AU 4758596 A	14/08/96
				BR 9606794 A	30/12/97
				CN 1078497 B	30/01/02
				CN 1179736 A	22/04/98
				DE 69622534 D,T	27/02/03
				EP 0806985 A,B	19/11/97
				JP 2001505476 T	24/04/01
				US 5575912 A	19/11/96
				US 5795477 A	18/08/98
				WO 9622835 A	01/08/96
US	4350282	A	21/09/82	AU 539749 B	11/10/84
				AU 8082882 A	20/07/82
				BR 8108934 A	30/11/82
				CA 1167817 A	22/05/84
				DE 3152648 T	10/02/83
				FR 2496497 A,B	25/06/82
				GB 2106807 A,B	20/04/83
				IT 1195247 B	12/10/88
				IT 8125738 D	00/00/00
				NL 8120499 T	01/11/82
				WO 8202153 A	08/07/82
				ZA 8108918 A	26/01/83

